Mr. Claude Fuller[7] of the Technological Museum, Sydney, has described and figured a very peculiar gall from a common Australian plant, which bears a striking resemblance to a caterpillar with its head and anterior parts of its body thrown back in an " attitude of defense." Neither "beetles nor inquilines seeking a suitable rearing ground for their young would be attracted by a caterpillar," thus protecting the inhabitants from injury from that source and though "insectivorous and predaceous birds might be attracted by it, they would at once be repelled by its woodiness while small wood pecking species, which might prey on its inhabitants would seldom be attracted by its appearance."

Dr. Otto Lugger[8] has prepared an extended report of the insects injurious in 1896, and of the parasites of man and the domestic animals.

EMBRYOLOGY.[1]

Breeding Habits of the Spotted Salamander.—The instincts and habits connected with the process of fertilization in the tailed amphibia are so remarkable, that even a few imperfect observations on these processes in our common salamander (*Amblystoma punctatum*) seem worth recording in the hope of aiding in some future comparative study that may throw light upon this puzzling chapter in Natural History.

Since Gasco[2] and Zeller[3] showed that the European triton and several other salamanders have an internal fertilization and yet no copulation, Jordan,[4] and also Gage,[5] have described much the same series of events in our common newt (*Diemyctylus viridescens*), while Ritter[6] has recently found similar phenomena in the western newt (*D. torosus*).

[7] Agricultural Gazette of New South Wales, VII, 697.

[8] Minnesota, Agr. Exp. Sta., Bull. 48.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Gli amori del tritone alpestre, Geneva, 1880, and Les amours des Axolotyls. Zool. Anz., IV, 1881.

[3] Ueber die Befruchtung bei den Urodelen. Zeit. f. wiss. Zool., 1890, XLIX.

[4] Spermatophores of Diemyctylus. Journal of Morphology, V, 1891; and Habits and Development of the Newt. Idem., VIII, 1893.

[5] Life History of the Vermillion-spotted Newt. AMER. NAT., Dec., 1891.

[6] Diemyctylus torosu. Proc. Cal. Acad. Nat. Sci. Zool., Vol. 1, Jan. 18, 1897.

From the excellent and detailed accounts given by Jordan we learn that during great sexual excitement the male clasps the female firmly for a long time; then the animals separate and a remarkable procession follows, the male going in advance deposits sperm in special cases, spermatophores, which are taken up by the female and subsequently used in fertilizing the eggs before they are laid, that is, the sexual embrace does not lead to transfer of sperm directly, but to subsequent deposition of spermatophores that are gathered up by the female. These spermatophores are small gelatinous masses containing sperm, and are taken into the cloaca of the female as she walks over them.

Apparently much the same series of events takes place in the breeding of Amblystoma. About Baltimore the eggs of this large salamander are very abundant in March and even in February in small pools in the woods, but the adults are then rarely seen. Since 1878 and '79 when F. S. Clarke[7] succeeded in obtaining a male and a female and saw the eggs deposited in captivity, the adults have very rarely been taken at the breeding season. Even when small pools, but four feet wide and nine inches deep, were thoroughly raked out before and after the eggs appeared, no adults were found, so that it was inferred that the laying takes place in the night and that the adults may even leave the water every day to conceal themselves under stones, etc. But this spring Mr. M. T. Sudler found a female moving away from a bunch of eggs early in the morning. This specimen kept isolated laid many eggs, and as these developed into normal larvæ, the existence of internal fertilization was proven.

In these small pools the laying of amblystoma eggs was preceded by 24 hours or so, last year and this, by the occurrence of white specks formed in lines on the dead twigs and leaves covering the bottom. These objects were quite conspicuous when the water was clear, and were at first thought to be some fungus growths from dead twigs, but on examination proved to be gelatinous pyramids or irregular cones of clear material bearing globoid, opaque, white enlargements at the tips. Each was about one half an inch high and firmly attached to a dead twig or leaf, generally at the edge of the latter as might be the case if put down from the clasping lips of the cloaca of Amblystoma. Distributed at intervals of a few inches they formed lines of several to a dozen. Microscopic examination showed the opaque tips to be a mass of coiled, densely packed filaments, highly refracting and at first sight apparently with no ends, yet appropriate stains differentiated the essen-

[7] The Development of *Amblystoma punctatum*. Studies Biol. Lab. J. H. U., Vol. I, Baltimore, 1879.

tial parts of spermatozoa and showed that these threads might well be the very large sperms of Amblystoma, seen and measured by S. F. Clarke. These masses thus agree essentially with the spermatophores of other tailless amphibia; they are more slender and higher than those of Diemyctylus, but built on the same general plan, and much less complex in form than those of the European triton.

Though it is most probable that these bodies are the spermatophores deposited by the male Amblystoma before the female lays the eggs, yet it is, perhaps, possible that they may yet prove to be but preliminary attempts at egg laying; the female depositing some sperm within such secretion as is normally formed about the eggs. But this latter assumption seems scarcely tenable.

We may conclude: (1). Fertilization in *Amblystoma punctatum* is internal (at least in the case observed). (2). Sperm-containing masses are often deposited before the eggs are laid; these are probably spermatophores put down by the male. (3). We may infer that the female gathers up the sperm from some of the spermatophores and that through this act the eggs are fertilized.—E. A. ANDREWS.

Cell Division and Nuclear Division.—Boveri[8] has repeated his notable attempts to fertilize non-nucleated pieces of the eggs of one species of sea-urchin (*Echinus tuberculatus*) with the sperm of another (*Strongylocentrotus lividus*) and finds incidentally some remarkable illustrations of the independence of nucleus and centrosome, and of the connection between the nucleus and cell division.

In most cases where only one sperm enters such a non-nucleated piece of egg of another species the first cell division results in forming two masses—one with all the nuclear matter of the sperm the other with one centrosome and no nuclear matter. The mass with the nucleus continues to divide and forms a small blastula that may live three days. The other does not divide but remains as a single mass adjacent to the dividing cell; inside it, however, the centrosome does divide and with the *same rhythm* as in the first mass, so that there are ultimately a large number of centrosomes and stars in a single cell or non-nucleated, undivided mass.

In fact the centrosomes go through all the phases they would in cell division, though the nucleus is absent!

Various facts and considerations lead the author to think it likely that the mitotic phenomena are started by conditions of the protoplasm that affect both the centrosome and the nucleus and lead them to go through their characteristic changes, independently of one another.

[8] Ph. Med. Verein, Wurzburg. Oct., 1896.

From the behavior of eggs that are entered by two or more sperms the author concludes that cell division does not take place without nuclear division. In these cases, at least, the egg divides into two, or into four cells or *partly* divides according as the asters have a nuclear spindle between them or not.

Moreover it is not the mere presence of the nucleus that is necessary for cell division but the nucleus must be connected with the centrosomes.

Visible Complexity of Protoplasm in Certain Eggs.—The great advances which have been made since the days when the nucleus of an egg was spoken of as a mere vesicle with one or more "spots" in it are well illustrated by the elaborate study made by the Abbé Carnoy[9] with assistance of H. Lebrun.

With remarkable patience, skill and trained imagination M. Carnoy has unraveled the complexities of structures seen in many thousands of sections of the eggs of certain salamanders and gained by ten years of labor a coherent conception of the successive changes these eggs undergo. The beautifully executed drawings that accompany the memoir show most remarkable arrangement of "chromatin" or staining material within the nucleus; the nucleus appears as a sphere of most complex and changeable structure—even the "spots" or nuclei within it having more complexity of structure than can be seen in many whole nuclei.

The paper describes the appearance of the egg nucleus at successive stages while it is growing ripe in the ovary. Chiefly *Salamandra maculosa* Laur. and *Pleurodeles Waltlii* Mich. served for material.

In the former, fertilization takes place about the first of July; the young are born alive the following Spring and leave the water towards September. The eggs in these young are about 200μ in diameter with a nucleus 110μ the end of the following May. The second May the eggs are 500–600μ and the third May, 1400. Not till the end of June, of the following year are they ready for fertilization; then they are 3500–3700μ. The eggs then require more than three years to develop and the females are about five years old when first ready for copulation.

As the egg enlarges during about three years the nucleus exhibits the successive changes described in outline below.

In the young ovarian eggs 30μ in diameter the large nucleus (18μ) contains a conspicuous filament of chromatin, which appears as a closed loop with no free ends. Besides this the nuclear sap is also resolvable into a very fine network of plastin (linin of some). This chromatic filament breaks up and parts of it remain as *nucleoli*. The nucleoli are thus all chromatic and not plasmatic in origin.

[9] La Cellule XII. Feb. 1, 1897, pps. 191–292, pls. 6.

It is subsequent changes in these nucleoli that constitute the remarkable, complex figures seen in the numerous illustrations.

The part of the original nuclear filament not concerned in forming nucleoli becomes *resolved* into innumerable minute granules. These granules arise from the filament in various ways somewhat as do similar granules from the nucleoli, as described below. The granules disperse in the nuclear sap, but not without reference to the pre-existing structure of that sap, in fact they seem to travel out along the strands of the plasmatic network. Ultimately these granules dissolve and the filament is henceforth represented only by the nucleoli.

We come thus to a stage in which the nucleus contains no visible objects except the chromatic nucleoli and the fine plasma net. The nucleoli, as they formed from the filament, went out to the periphery of the nucleus to lie near its membrane. They next begin a migration inwards towards the central part of the nucleus and enlarging become *resolved* into remarkable figures. These figures are different in successive years and even in different animals and much of the labor of the authors has been the attempt to arrange the large mass of material in some classified order.

These figures continue to be found all through the growth of the egg; *successive generations of nucleoli arise and are resolved into figures.*

Many of the figures would be taken for arrangements of chromatin directly arising from the original loop—others seems strange and bizarre.

Any continuity of chromatin seems here out of question, except as the nucleoli first arise from chromatin and subsequently are continued as successive generations of chromatic figures; any attempt to trace continues chromatic bodies, chromosomes—seems most impossible.

We cannot attempt in the limit of a short abstract to mention the numerous shapes the nucleoli assume in the process of resolution. Starting from the form of a spheroidal, apparently homogeneous body the nucleolus may swell up into a spongy mass that transforms into a large network of complex strands, each composed of innumerable granules. Or the nucleolus may branch out into plume and brush-like figures, often resembling a test-tube-or lamp-chimney-cleaner. Other nuclei form branching trees, coiled filaments, groups of balls with filamentous connections, stars and radiating masses looking like spattered paint.

Some of the figures are found only at certain periods of the year others in various stages of the development of the egg; some periods are characterized by the occurrence of only one form of figures while others have a prevailing form and others a mixture of many forms.

The time taken to form the figures cannot be determined, but apparently the various generations of nucleoli follow rapidly, each being resolved into the figures and the figures forming granules and the granules dissolving into the material that presumably dissolves away into the cell protoplasm to help form the yolk.

The successive generations of nucleoli arise from preceeding ones; the first nucleoli come as stated above from the original chromatic filament, the following generations arise from the *granules*, into which the nucleoli disintegrate—some granules not dissolving but persisting; later some nucleoli arise from *spherules* or larger fragments of figures that do not break down into the minute granules. In either case the new nucleoli arise near the nucleolar membrane; in the first case from many granules that become enveloped by a membrane in the second case by the union of several spherules or else by the enlargement of a single spherule.

Now the granules are arranged along the plastin network and when many combine to form a new nucleolus that nucleolus is a structured and complex body having in it a network with granules and an outside membrane. Though the nucleolus looks homogeneous yet actual sections of nucleoli may show the outside membrane, the plastin network and the granules or filaments of chromatin: in *fact the nucleolus has the same structure as the nucleus.* This is seen in section and again when the nucleolus passes into the interior of the nucleus to be resolved into some complex figure; it may then even come out of its membrane and, as it were, grow out in a tree like net with chromatin on the meshes.

Before speaking of the interesting descriptions of the formation of yolk, outside the nucleus, we may venture to restate the above brief outline of the process of resolution of nucleoli in comparing it with a complex series of pyrotechnic displays. The nucleoli are like most complicated fireworks arranged about the periphery of the nucleus—apparently simple but complex in internal arrangement. They move inwards towards the centre of the nucleus—as if discharged and then unfold the most diverse stars, feathers, coils, nets, etc., that ultimately burst into the smallest sparks, granules, scattering outwards through the nucleus along the network of plastin that fills the entire area. When most of these sparks are quenched some few are coming together near the old point of discharge and fashioning a complex rocket, Roman candle, or wheel that will in turn be set off at the succeeding display of figures—and so on for several years.

Thus innumerable granules are formed and dissolved, few keeping intact to form the next generation. One result of the great manufacture of granules is, the author conceives, the formation of yolk in the egg.

The yolk begins to appear when the egg is only 300μ in diameter and grows to be the large mass of crystal-like bodies familiar in the eggs of Amphibia. The first perceived change in the egg protoplasm is the occurrence of minute areas near the cell periphery ; areas which include a considerable number of the spaces of the plastin network and become recognizable from the rest of the network by a difference in refraction, looking as if the spaces of the net were filled in by solid albumen. Such changed areas ultimately fuse together to form a zone in peripheral part of the egg and as the yolk increases this zone extends in toward the nucleus, more and more. In one of the small areas there appear exceedingly minute granules along the lines of the net—these are the young yolk granules that enlarge as if small crystals growing in a solution. This solution is thought to be furnished by the combined activity of nucleus and egg protoplasm; the nucleus furnishing paranucleic acid and the egg protoplasms the globulins; these combining make paranuclein and then vitilline—the yolk granule. The generations of figures in the nucleus form granules of nuclein that dissolve and by hydrolosis the nucleic acid is set free—this becomes the paranucleic acid that is supposed to soak out through the cell to the region where yolk is to form. However this may be, the granules of yolk enlarge and appear scattered in stout strands or cords of protoplasm that run amongst vacules or water spaces in the egg. Hitherto there have been no vacules in the egg and the author denies that there is anything comparable to the foam-structure of Büschli; the vacules that now appear are, he thinks, due to the absorbtion of water by the globulins. The vacules may become large and be subdivided by strands of protoplasm going across them. The water thus collected is later seen in deeper parts of the egg towards the nucleus and the egg thus takes on a *spongy* structure as the yolk develops. The minute yolk granules move centrally from this first place of origins in the strands amidst the vacules and now get into the spongy protoplasm; here each one may get into a watery vacule and grow to its definition size and form. The yolk granules thus start in the plastic net and end in a vacule; how this change is brought about is not evident from the author's account.

The interesting introductory statement and the author's views upon the centrosome question cannot be reviewed here as they do not bear directly upon the present subject.